

mains, based upon a vast accumulation of evidence, that the higher anthropoids, especially the chimpanzee and the gorilla, are man's nearest surviving relatives, and that the remote 'common ancestor' of perhaps ten million years ago was a tail-less, partly tree-living, pro-anthropoid, in many respects far more like a young female chimpanzee than like a modern white man."

Professor S. J. Holmes discusses "the human side of apes" and shows how recent study, at once more thorough and more sympathetic than before, has greatly heightened the zoologist's appreciation of the mental abilities of the higher apes. "As we learn more of the ways of these creatures, it becomes more apparent to us not only that we are very much like them but that they are very much like us."

Very valuable is the account which Professor Elliot Smith gives of the evolution of the brain, especially of the cerebral cortex, in the higher mammals and in the Primates in particular: "The brain affords evidence in corroboration of man's origin from an ancestor common to man and ape that is too exact and impressive to admit of any doubt as to its significance."

Finis coronat opus; the volume ends, as it began and continued, *with distinction*. Julian Huxley discusses progress in evolution—progress that is going on, but attended, as ever, with possibilities of regress. Lloyd Morgan writes, like the sage he is, of the role of Mind in evolution, and on the legitimacy of combining scientific evolutionism with a philosophical or religious belief in a Divine Purpose behind it all. Professor H. H. Newman ends fitly with emphasis on the cumulativeness of the book's argument, and he also declares that "Evolution no more takes God out of the universe than does gravitation."

Mrs. Mason is to be heartily congratulated on her idea of a co-operative volume in which each investigator is allowed his own way of illustrating or discussing a big problem. The result is as happy as it is useful.

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LAMARCKISM

King, Helen Dean, and Donaldson, Henry H. *The Life Processes and Size of the Body and Organs of the Gray Norway Rat during ten generations in Captivity*. (No. 14 of the American Anatomical Memoirs.) Philadelphia, 1929. Wistar Institute. Pp. 106. Price \$3.50.

McDougall, Professor William, M.B., F.R.S. *Second Report on a Lamarckian Experiment* (appearing in the *British Journal of Psychology*: General Section, Vol. XX, Part 3. January, 1930).

BOTH these independent communications, appearing within a few months of each other, recount a series of experiments on rats, and both strongly suggest, at first reading, that 'acquired characters' are inherited.

The object of Miss King, who is responsible for the first part of the first paper, was to discover in exactly what ways wild animals differ from their domesticated cousins, and how the second type has been evolved from the first. So in 1919 she procured, by trapping, sixteen males and twenty females of the wild gray Norway rat—i.e. the common rat. Six of these females had litters, the members of which constituted the first of ten generations of captive grays.

Briefly stated, slight but definite changes occurred in the rate and extent of body growth as the generations advanced. In the tenth generation, growth during early life was much more rapid than it had been in animals of the first generation, though growth during adult life changed relatively little. Males of the tenth generation were also significantly less variable in body weight throughout adult life, but not during early life; while females of this generation showed a slight decrease in variability at all age periods. In both sexes the trend of variability was towards that found in the Institute's stock albino rats, which can fairly be considered domesticated animals; and the evidence indicates that this vari-

ability was due, in part, to the genetic differences of the individuals.

The females of the later generations began to breed earlier than had their ancestors, while sterility steadily decreased and fertility rose; in both sexes mortality also fell steadily. Further marked changes occurred in behaviour during the generations, as the rats gradually lost much of their savageness and fear of man, and their nervous tension decreased.

The account, in short, closely parallels what one would imagine must have been the history of our farmyard animals when they were first domesticated.

About twenty rats of each sex in each generation were killed and dissected by Dr. Donaldson, whose observations are here given very briefly.

There was a slight but definite increase in the ratio of body weight to body length. The weight of the hypophysis increased slightly, while that of the brain, the thyroid, and the suprarenals, especially the suprarenals of the female, fell. In the organs of lesser weight the greater loss occurred in the first captive generation—that is, the first born in captivity as contrasted with their wild parents—and there was no subsequent progressive loss, save in the thyroid.

The ratio of body weight to body length and the weight of the thyroid were the same as those of the albino, though the brain, the suprarenals (especially in the male), the gonads, and the bones remained heavy compared with those of the albino. The hypophysis, especially of the female, remained lighter than that of the albino. "Ten generations of captivity have, by no means, served to give the captive grays the organ constitution of the Albino."

Since this is only a preliminary report on an experiment which must take several more years, at least, to complete, both authors refrain from attempting any interpretation or explanation of their results.

Professor McDougall's, on the other hand, is the second of two reports; and though he is continuing the experiments, he now feels justified in drawing conclusions from the results so far achieved.

Readers of this REVIEW will probably remember the first report.* It described how two halves of a stock of pure-bred white rats were trained generation by generation in two different tasks. One task consisted in learning to escape from a water-maze; and the other in learning to escape from a tank of water by the less brightly illuminated of two gangways. The instinctive tendency of the rats in the latter experiment was at first to take the more brightly lit gangway, which, however, gave them an electric shock. In both experiments the later generations of rats seemed to learn their task more quickly than their forbears.

Since the maze procedure was in several respects less satisfactory than the tank experiment, it was abandoned; and the present report deals only with the continuation of the tank experiment from 1926 to 1929, a period which covers ten generations of rats. These repeated the performance of their thirteen generations of predecessors, and continued, generation by generation, to learn their task more quickly. Untrained 'control' rats made on the average about 165 errors, receiving the same number of electric shocks, before learning to avoid the bright gangway (this parallels the performance of the first rats trained), while the twenty-third generation of trained rats made on the average only twenty-five errors.

After considering and rejecting other possible explanations, Professor McDougall writes:

"It begins to look to me as though Lamarckian transmission were a real process in nature; and I submit for criticism the proposition that, if continuance of the experiment, combining training with strongly adverse selection, should result in steadily increasing facility, the reality of Lamarckian transmission will have been demonstrated."

Now there are several reasons why any apparent inheritance of 'acquired characters' should be regarded with scepticism even greater than is normal in the interpretation of biological phenomena. Firstly, all

* In the *British Journal of Psychology*, April 1927.

species are always in a process of evolution : they change from generation to generation, and though that change usually bears the appearance, at first sight, of the inheritance of acquirement, it may in fact be due to several causes. It may be only the usual adaptation of a race genetically unchanged to a changed environment. It may be due to migration, to differential birth rates or death rates—broadly, to selection of old varieties or new mutations—or simply to the steady, intensifying process of inbreeding. Change, therefore, as some ardent disciples of Larmarckism forget, is no argument for their hypothesis, whether it be the change before our eyes or the steady development or modification of fossil forms in successive strata of rocks.

Secondly, Lamarckism runs counter to the whole structure and rationale of the thirty-years' old science of genetics and to all it has taught us about factorial transmission. It is not possible to conceive how a modification of some part of an individual can so influence the appropriate genes in his gonads that they later cause an analogous modification in the offspring into which they develop.

Thirdly, while countless attempts have been made to induce the inheritance of acquirement, not one has succeeded.

The hypothesis can now only be accepted on the most unimpeachable evidence it is possible to imagine.

The King-Donaldson experiment need not detain us very long. It is very fine work, but it was not designed to test the reality of Lamarckian transmission, and its slight but definite results are more easily and reasonably explained otherwise :

(1) There was very little mortality, so that the selective death rate which presumably keeps wild rats adapted to their surroundings was not operative.

(2) Out of twenty females caught, only six bred—the six that were better adapted than their fellows to captive conditions? Most of the rats in the first, and some in the second, generation were very savage and unmanageable. Many of those that did breed, afterwards destroyed their young.

These phenomena grew less marked after the second generation, as only the more amenable strains survived.

(3) As a result of this early elimination, there was necessarily a slight but definite degree of inbreeding, sufficient to intensify the qualities already selected for survival, and also to cause the fall in variability.

(4) It is significant that the change took place in the hypophysis, thyroid, and suprarenals, which influence metabolism, growth, breeding, and temperament. Slight selection for one or more of these physiological factors would be sufficient to account for the other changes. Or perhaps psychological adaptation to captivity gradually increased, and so affected the endocrine system.

What perhaps is important—and perhaps not—is the fact that the strain 'broke' at the eleventh generation, and several mutations occurred.

McDougall's work, on the other hand, was definitely and very carefully designed to test the transmission of acquirement, and every effort was made to eliminate all other possible explanations of any results that ensued.

To begin with, we can obviously eliminate the factor which has vitiated so many previous experiments, the bias of the investigators. Next, we can agree with McDougall that a series of small mutations cannot reasonably be held responsible for the slowly increasing learning facility of his rats. Finally, he seems fully justified in considering that selection cannot account for his results : mortality was negligible, and it would have been quite impossible for the investigators, even had they wished, to know which rats of each litter would be the best learners. Moreover, he actually tried the further experiment of adverse selection, and bred from the worst learners in three successive generations of 'control' stock which had previously been trained for two. Yet still the children of the first worst learners surpassed their parents, and the grandchildren surpassed the children.

Lastly, he crossed quick learning males of the trained stock with some of these worst

female 'controls,' and found that the average errors of their progeny were also significantly fewer than the errors of the earlier progeny of the same mothers by worst males. This, in particular, seems to McDougall very strong evidence of the genetic basis of the learning facility.

Now, the first question a geneticist must ask is: What is this faculty that is supposed to be genetically transmitted? McDougall discusses, but does not answer this question. Next, a character that is thus transmitted must obviously have a physical basis—what is it? And are we to infer that if the experiment was long enough continued this character would become so intensified as to render it unnecessary for the rats to learn at all?—which would be the logical conclusion. Even so simple a thing as fear of an electric shock—let alone connecting it with a light—depends upon an immensely complex series of psychological and physiological reactions. Can these, modified or not, be put up in a parcel, so to speak, and posted to the next generation?

Faced with such questions, one turns to see whether the results are not susceptible of an entirely non-genetical explanation. The reader will at once see the point if he will momentarily suppose that the rats were human beings faced with the problem of finding their way out of, say, the inner depths of the Admiralty. Children who had never before heard of the architecture of government departments would be bitten by innumerable Admirals-of-the-Fleet before they found their way into the street; while children whose parents had travelled the road would soon escape with a few minor nips.

Rats, as anyone who has handled them knows, have not only a highly-developed intelligence, but considerable social gifts: they can talk to one another and collaborate in comparatively intricate schemes. My serious hypothesis is that McDougall's results are due to social, not biological, inheritance. Since the brains of rats are less highly developed than men's, it takes them longer to learn and to teach; but eventually,

in circumstances such as these, they do build up a social tradition which becomes more perfect in each generation.

That leading Lamarckian, Professor MacBride, has himself recently recalled in this REVIEW (July 1929, page 103) a remarkably similar instance of the growth of a social tradition among birds, in circumstances which preclude any possibility of the inheritance of acquirement. I quote his own report of Eimer's observations during the last century:

"He was desirous of obtaining a large number of sparrows for purposes of dissection, and so he constructed a trap which he thought suitable for the purpose. This consisted of a long tunnel which bent at the end at a right angle so that the inner end which contained the snare could not be seen from the outside. The birds were induced to enter by a number of baits set along the length of the tunnel, and no bird that went to the end of the tunnel ever escaped. The first year Eimer caught quite a large number of sparrows. The second year he caught only seven, and those were all young birds, and the third year he caught none!" (One assumes, of course, that sparrows were plentiful in all three years.)

This case closely parallels that of the rats; and, were it not obviously impossible for dead birds to breed, would doubtless be quoted as an instance of the inheritance of acquirement. The same account, however, tells how and why the birds learned to avoid the trap, and suggests the possibility of a somewhat similar process among the rats:

"He noticed during the second year that whenever a young bird approached the opening of the tunnel the older birds began to sound loudly the appropriate danger cry, and in most cases dissuaded the young one from entering. . . ."

There does seem, however, to be one genuine genetic factor involved in the rat experiment—the individual differences between clever and stupid rats. It was this factor, I suggest, which caused the difference between the progeny of the worst females \times worst males and those of the same females mated to good males. I suspect

that if those females had been mated to the worst learners among the trained rats, the performance of their progeny would have been no different from that of the previous litters, except in so far as the mothers would have had a longer time to learn and teach their lesson.

McDougall does consider the possibility of some form of communication between rat and rat, but dismisses it rather summarily. To me, however, it seems the crux of the whole question. Fortunately, it can be easily put to the test in more than one way.

(1) The training of the trained rats should be discontinued for two clear generations; and the learning facility of the third generation then tested.

(2) Newly-born litters of untrained rats should be given to training foster-mothers of trained stock.

(3) The reverse to (2).

(4) As a refinement of (2) and (3) some of the litters tested should be half of trained and half of untrained stock, and some of these mixed litters should be reared by training females of trained stock and some by untrained females.

(5) Individual rats of both stocks should be securely segregated from communicating with each other before and during training, while another group should be kept in a colony.

Also, some effort could perhaps be made to discover what are the physical factors involved, and so to give yet further value to an exceptionally fine piece of work.

F. A. E. CREW.

LEGAL

The Eugenics Society. *Family Council Law in Europe.* London, 1930. Pp. 86+xi. Price 3s. 6d.

THIS little book, which has been produced and issued by the Eugenics Society, is the outcome of an inquiry "into the method of the appointment and the functions of Family Councils in existence in some continental countries, as a means of deal-

ing with a certain class of weak-willed irresponsible individuals on the border line of certification."

The investigation was rendered possible by the generosity of a Fellow of the Society who provided a sum of money for the purpose, but desires to remain anonymous.

The Council of the Society appointed a committee, with Mr. C. J. Bond as chairman, to inquire into the subject, and this committee arranged with Mrs. K. E. Trounson to carry out the investigation in the different continental countries. The present book is in substance the report of the committee; it embodies Mrs. Trounson's researches with an introduction written by her; and contains a sketch of the methods adopted in eight different countries (including our own) for dealing with the mentally deficient. The summary of the English law on the subject is supplied by Mr. W. H. Gattie, Barrister-at-law.

The subject is a difficult and complicated one, and it is no small achievement to have given an adequate summary of the mental-deficiency laws of so many countries within the limits of this one small volume. The book will be of great utility to students of the subject, and all concerned in its production are to be congratulated on the successful accomplishment of their task.

It is very interesting to study the methods adopted by different countries to attain the same end—the care of the persons and property of incapables—but it is doubtful whether there is much that we could usefully borrow from any of the continental systems dealt with in this book. Our own procedure for getting the persons and property of defectives placed under proper control seems to your reviewer both more expeditious and less cumbrous than that which prevails in the countries that have adopted the Family Council principle—or indeed in any of those countries whose systems are described in this book, some of which are not, strictly speaking, Family Council systems.

The trouble is that the provisions of our law on this subject are not sufficiently well